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Volume 26, New Laboratory Methods for Characterizing the Immersion Factors of Irradiance Sensors

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Chapter 4

The ComPACT Method for Determining Immersion Factors

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Abstract

The determination of the immersion factor using the traditional method implemented in different laboratories has highlighted the importance of water purity to minimize uncertainties. The reduction in the size of the water vessel used in the experimental setup, reduces the volume of water required to fill the tank, thereby making it practical to use pure water in the characterization of immersion factors. The ComPACT method uses a small water vessel (containing approximately 3 L of water) which makes it practical to use pure water during $I_f(\lambda)$ determinations. This leads to the possibility of better standardizing the method for $I_f(\lambda)$ characterization and thus reducing the differences in its determinations at different sites.

4.1 INTRODUCTION

The SIRREX-8 activity showed a variety of laboratory measurement setups for the determination of $I_f(\lambda)$, which relied on the same protocol (Mueller and Austin 1995). A major element differentiating the implementation of the protocol was the use of different types and volumes of water. This showed the difficulty in standardizing measurements. In fact, water purity may significantly affect the accuracy of the computed $I_f(\lambda)$ values. The reduction in size of the water tank used for making the measurements with the instrument immersed is a viable solution to ensure a better control of the water quality. The ComPACT method makes use of a small tank (containing approximately 3 L of water) which permits the use of pure water (e.g., Milli-Q™†) for the determination of the $I_f(\lambda)$ values. This solution creates the possibility of standardizing immersion factor measurements.

4.2 LABORATORY SETUP

A schematic of the ComPACT method, as implemented at the JRC, is illustrated in Fig. 4. The general apparatus for the ComPACT method is the same one used during the SIRREX-8 activity, except the large water tanks (primary measurement tank and companion storage tank) have been replaced with the ComPACT water vessel and a small waste water tank. The radiometer to be characterized is shown attached to the bottom of the ComPACT water vessel, and this entire system is attached to an optical bench. The light source (a 1,000 W tungsten-halogen lamp), a lamp screen with primary baffle, and a monitoring radiometer for the light source are also installed on the optical bench, and all of these optical components can be independently positioned.

The alignment of the optical components is accomplished using a laser that is temporarily inserted in the clamp support of the monitoring sensor. A shunt resistor, in series with the lamp, is used as an additional means to monitor the light source stability. This is accomplished by measuring the voltages across the shunt and the lamp with two DVMs. Two independent data loggers (so-called *DATA-100s*) are used for powering the in-water and the monitoring sensors, and converting the analog voltages to a serial telemetry that is recorded with a laptop computer.

To protect the lamp in the event of a power failure, the lamp power supply and the lamp fan are connected to an uninterruptible power supply (UPS). The purpose of the lamp fan is to prevent an excessive heat buildup on the lamp screen and the monitoring sensor. The movement of air away from the central axis of the instrumentation, also minimizes the flux of particles into the water vessel.

† "Milli-Q" is a registered trademark of Millipore Corporation (Bedford, Massachusetts).